

STABILISER, JETTING AND CIRCULATING TOOL

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The present invention relates to downhole tools used in oil and gas wells and in particular to a downhole tool which provides the combined functions of stabilising, jetting fluid and circulating fluid within the well bore.

In drilling or completing a well bore, it has been recognised that significant time and cost savings can be made if a number of tools providing different functions can be mounted on the same work string and run together into the well bore. Each tool mounted on the work string must be capable of being operated independently. A large number of methods of operating tools on a work string have been developed and they typically include ball activated, weight activated or hydraulically activated tools.

However there are disadvantages in providing so many tools on a work string. The location of each tool within the well bore must be considered so that the string requires minimal repositioning and reciprocation in the well bore to operate each tool. Additionally the time and

1 requirements in making up the string prior to the run
2 must be carefully considered as the string can have an
3 excessive working length.

4
5 It would therefore be advantageous to provide a downhole
6 tool for use on a work string which can provide a
7 plurality of functions within the well bore and therefore
8 reduce the number of tools which require to be mounted on
9 a work string.

10
11 It is an object of the present invention to provide a
12 downhole tool which can operate in a number of functional
13 modes simultaneously within a well bore.

14
15 It is a further object of at least one embodiment of the
16 present invention to provide a downhole tool which
17 performs the functions of stabilising, jetting and
18 circulating fluid simultaneously within a well bore.

19
20 It is a further object of at least one embodiment of the
21 present invention to provide a downhole tool in which one
22 or more functions can be selectively performed from a
23 selection of functions on the tool.

24
25 According to a first aspect of the present invention
26 there is provided a downhole tool for use in a well bore,
27 the tool comprising:

28 a tubular body having an axial throughbore and
29 adapted for connection within a work string;
30 a sleeve mounted around the body, the sleeve
31 including one or more stabiliser blades, said
32 stabiliser blades including one more jetting ports

1 to direct fluid from the axial throughbore onto a
2 surface of the well bore; and
3 one or more actuating means to selectively direct
4 the fluid through the jetting ports and thereby
5 circulate the fluid.

6
7 Thus, the downhole tool of the present invention provides
8 a stabilising function, a jetting function for cleaning
9 and a fluid circulating function within a well bore. It
10 will be appreciated that the term well bore covers
11 tubulars such as a casing or liner located in the bore.

12
13 Preferably, the one or more actuating means provides a
14 cyclic function. That is the one or more actuating means
15 can be operated to provide at least one cycle wherein
16 each cycle is an on/off/on or alternatively an off/on/off
17 function with respect to the exit of fluid through the
18 jetting ports.

19
20 In a preferred embodiment of the present invention, the
21 actuating means provides two cycles.

22
23 Preferably also, the actuating means is selected from a
24 group comprising ball activated, weight activated and
25 hydraulically activated or a combination thereof.

26
27 Preferably, the sleeve is threaded onto the body. More
28 preferably, the thread is a left-hand thread and thus
29 advantageously the sleeve will tighten while rotating.
30 Preferably, also, the outer diameter of the stabiliser
31 blades on the sleeve are sized to be close to the inner
32 diameter of the tubular in use. Thus, a large outer
33 diameter of the tool provided at the stabiliser blades

1 will improve the jetting effectiveness. Preferably, the
2 stabiliser blades are arranged in a helical pattern
3 around the sleeve. More preferably, there is a
4 triangular flow-by groove between adjacent stabiliser
5 blades. Such triangular flow-by grooves minimise cutting
6 action on the surface of the well bore.

7
8 Preferably, the/each stabiliser blade has a central
9 portion including a surface parallel to the axial
10 throughbore. Advantageously, the one or more jetting
11 ports are arranged on the parallel surface of the
12 stabiliser blades. Thus, the jetting ports are arranged
13 at the closest position to the surface of the well bore.

14
15 Preferably also the blades include a milling surface.
16 Preferably, the milling surface is at a leading end of
17 the work string. Advantageously, the milling surface is
18 of tungsten carbide to provide a reaming or cutting
19 function and assist the tool in clearing obstacles and/or
20 removing debris from the surface of the well bore.

21
22 The jetting ports may be arranged substantially
23 perpendicular to the axial throughbore. More preferably,
24 one or more jetting ports are arranged at an angle to the
25 perpendicular to provide a larger cleaning surface
26 against the surface of the well bore when the fluid is
27 jetted.

28
29 Advantageously, each jetting port includes a nozzle. The
30 nozzle may be located at an exit of the jetting port. The
31 nozzles reduce the diameter available for fluid flow and
32 thereby increase the velocity of the flow as it exits the
33 tool. Advantageously, each nozzle is located below the

1 outer surface of the sleeve. This provides an advantage
2 in allowing wear of the tool to occur without obstructing
3 the nozzle so that the nozzles may be removed and
4 installed easily.

5
6 Preferably, a channel is located between the body and the
7 sleeve. Preferably, also, the jetting ports access the
8 channel. Advantageously, the one or more actuating means
9 direct fluid from the axial throughbore to the channel
10 prior to the fluid flowing through the jetting ports.
11 Thus, as the same jetting ports are used, each time the
12 actuating means operates, this minimises the potential
13 for leaks within the tool.

14
15 Embodiments of the present invention will now be
16 described, by way of example only, with reference to the
17 following Figures in which:

18
19 Figure 1 is a part cross-sectional schematic view of a
20 downhole tool according to a preferred embodiment of the
21 present invention;

22
23 Figure 2 is a cross-sectional schematic view of the
24 actuating means used in the tool of Figure 1. Figures
25 (a), (b) and (c) illustrate the actuating positions of
26 the tool.

27
28 Figure 3 shows an alternative actuating means, which may
29 be used in the downhole tool of the present invention.

30
31 Reference is initially made to Figure 1 of the drawings,
32 which illustrates a downhole tool generally indicated by
33 Reference Numeral 10, according to a preferred embodiment

1 of the present invention. Tool 10 has an upper end,
2 including a box section 14 for connection in a work
3 string (not shown). Tool 10 also has a lower end 16,
4 which includes a pin section 18 for connection in a work
5 string mounted below the tool 10. It will be appreciated
6 that although the references to upper and lower are
7 provided it will be understood by those skilled in the
8 art that the downhole tool of the present invention could
9 be used in a vertical, inclined or a horizontal position
10 in a well bore. It will further be appreciated that the
11 tool of the present invention has application within a
12 well bore during drilling operation or in a cased or
13 lined well bore where a tubular has been inserted during
14 completion.

15

16 Tool 10 comprises a tubular body 20. A sleeve 22, is
17 mounted around the body 20, and is held in place by a
18 threaded connection 24. The thread is left-handed so
19 that when the tool is rotated the sleeve 22 will be
20 tightened onto the body 20. O-rings 26, 28 are located
21 between the body 20 and the sleeve 22, to prevent the
22 ingress of dirt or the outflow of pressure between body
23 20 and the sleeve 22.

24

25 Mounted on sleeve 22 are a number of blades 30. Blades
26 30 are arranged in a helical or spiral pattern on the
27 sleeve 22. Each blade has a longitudinal body 32 with a
28 sloping front face 34 and a sloping back face 36. The
29 front face 34 has a hardened surface 38, which partly
30 extends onto a planar surface 40 between the sloping
31 faces 34,36. The hardened surface 38 allows the blades
32 30 to contact debris or other obstacles within the well
33 bore and mill them or clean them off.

1

2 Between the blades 30 are located channels 42. The
3 channels 42 have a triangular cross-section and act as
4 flow-by grooves between the blades to minimise cutting
5 action of the blades on the formation in the well bore.
6 Located on the planar section 40 of each blade are three
7 jetting ports 44A, B and C. Each port 44 A, B and C
8 provides access between a back surface 46 of the sleeve
9 22 and a front surface 48 of the sleeve 22.

10

11 The inlet ports 44A, B and C are arranged so that the
12 central port 44B is perpendicular to a central bore 50
13 which runs through the body 20 while the ports 44A and C
14 are angled with respect to port 44B. Each port 44
15 includes a nozzle 52, which reduces the diameter of the
16 port 44 and thereby increases the speed of fluid passing
17 through the port 44. Each port 44, contacts a channel
18 54, located between the body 20 and the sleeve 22. This
19 channel houses fluid and the o-rings 26, 28 prevent the
20 fluid from escaping from the tool 10 by means other than
21 those provided at ports 44.

22

23 Within the body 20 there are located two inlet ports, 56,
24 58. Each inlet port 56, 58 is associated with an
25 actuating means 60, 62. The actuating means 60, 62 are
26 primarily located within the central bore 50. The
27 actuating means 60, 62 control the passage of fluid
28 within the central bore 50, through the ports 56, 58
29 respectively and into channel 54. This controls the
30 passage of fluid out of the tool via the inlet ports 44.
31 It will be appreciated that although only one inlet port
32 56, 58 is associated with each actuating means 60, 62
33 there may be any number of inlet ports 56, 58 and equally

1 any number of actuating means 60, 62 as long as the fluid
2 from each is located within the channel 54.

3

4 Reference is now made to Figure 2 of the drawings which
5 illustrate an actuating means, generally indicated by
6 Reference Numeral 62, as would be found in the tool of
7 Figure 1. Like parts to those of Figure 1 have been
8 given the same Reference Numerals to aid interpretation.

9 The actuating means 62 is a drop ball activation means as
10 would typically be found in a downhole tool. An example
11 of such a downhole tool would be US 6,253,861 to
12 Specialised Petroleum Services Group Limited, the present
13 Applicant. US 6,253,861 is hereby incorporated by
14 reference.

15

16 Actuating means 62 comprises first 64 and second 66
17 sleeves arranged concentrically within the body 20. Each
18 sleeve, 64, 66 includes a respective port 68, 70. The
19 ports 68, 70 provide access through the sleeves 64,66.
20 It will be appreciated that each port 68, 70 generally
21 comprises a plurality of ports circumferentially arranged
22 on the sleeve 64, 66. As shown in Figure (a) the sleeves
23 are initially arranged side by side and held together via
24 a shear pin 72. Further, the pair of sleeves 64,66 are
25 held to the body by means of a second shear pin 74.
26 Shear pin 74 is located through the body 20 and into the
27 first sleeve 64.

28

29 In use, the tool 10 is run into the well bore or tubular.
30 The diameter of the tool 10 at the blades 30 would be
31 selected to provide a small clearance between the tool
32 and the surface of the well bore or tubular. A typical
33 clearance may be a number of millimetres.

1
2 Once located at the point where fluid is required to be
3 jetted or circulated a drop ball 76 is inserted into the
4 central bore 50 to travel through the body and locate in
5 a ball seat 78 of the second sleeve 66. Ball 76 blocks
6 the axial passage of fluid through the bore 50 and as a
7 result pressure will build up on an upper surface 80 of
8 the ball 76. The increase in pressure will shear the pin
9 74 and allow the sleeves 66, 64 to move axially through
10 the bore 50. The sleeves 64, 66 will move together by
11 virtue of the shear pin 72. The sleeves 64, 66 travel to
12 a stop 82. At the stop 82 the sleeve 64 and 66 are
13 positioned such that the ports 68 and 70 align with the
14 port 58 and thereby allow fluid in the bore 50 to enter a
15 channel 54 and exit the jetting ports 44.

16
17 Once the jetting and circulation requirement is complete
18 the tool 10 can be closed as shown in Figure 2(c) by
19 virtue of a second drop ball 84 being inserted through
20 the bore 50. Ball 84 is a larger diameter than ball 76
21 and locates on a ball seat 86 on the second sleeve 66.
22 Ball 84 prevents the passage of fluid through the bore 50
23 and thereby pressure increases on its upper surface 88
24 until the shear pin 72 shears and the sleeves 64 and 66
25 disengage from each other. On disengagement the
26 innermost sleeve 66 will fall relative to the outer
27 sleeve 64. The innermost sleeve falls a distance to a
28 second stop. In this position a by-pass channel 90 in
29 the first sleeve 64 provides a passage of fluid around
30 the drop ball 84. Similarly, at drop ball 76 a by-pass
31 passage towards the body 20 is now accessed from ports 92
32 in the sleeve 66.

33

1 Thus, in the closed position the port 70 of the inner
2 sleeve 66 is now misaligned with the port 66 of the outer
3 sleeve and the port 58 leading to the channel 54. By
4 the insertion of two drop balls, the tool has performed
5 one cyclic function in taking the jets 44 from a closed
6 position to an open position and again to a closed
7 position.

8
9 Referring back to Figure 1, it will be seen that a
10 similar actuating means as shown in Figure 2 can be
11 located at position 60 and through port 56. A second
12 cyclic motion can be performed. In this regard, a twin
13 cycle is possible with tool 10 and thus by timed
14 insertions of drop balls of sufficient diameter the
15 jetting ports 44 can function in a selective on or off
16 position.

17
18 As will be appreciated by those skilled in the art the
19 actuator means 60, 62 in Figure 1 may be replaced by any
20 actuator means which causes selective opening and closing
21 of a channel 56, 58 into the channel 54 to give access to
22 the ports 44.

23
24 Reference is now made to Figure 3 of the drawings which
25 illustrates a portion of a circulation tool generally
26 indicated by Reference Numeral 100 which could be used as
27 the actuating means 60, 62 of a downhole tool of the
28 present invention. Like parts to those of Figure 1 have
29 been given the same Reference Numeral. As with Figure 1,
30 the actuator means 100 is positioned on the body 20 which
31 has a central bore 50. The actuator means comprises a
32 sleeve 102 located on the body 20 which is biased against
33 the body by means of a helical spring 104 housed between

1 ledges 105, 107 on the sleeve 102 and body 20
2 respectively. Located in the sleeve 102 are two vent
3 holes 106, 108, which permit the equalisation of pressure
4 outside the sleeve 102 with pressures between the sleeve
5 102 and the body 20. Located in the sleeve 102 are a
6 plurality of ports 130. Also mounted on the body 20 are
7 five O-ring seals 112, which sealingly engage with the
8 sleeve 102. On the inside of the sleeve 102 adjacent to
9 circulating ports 110 is an internal groove 114 found on
10 the inner surface of the sleeve 102.

11

12 Below the sleeve 102 is a spring tensioner ring 116 which
13 is threadably engaged to the body 20 through a thread
14 formation 117. A set screw 124 is provided to lock the
15 spring tensioner 116 in position on the body 20.

16

17 The spring tensioner 116 has a single shoulder 118 to
18 which hard facing in the form of tungsten carbide 119 is
19 applied. At the lower end of the sleeve 102 adjacent to
20 spring tensioner ring 116, an actuating shoulder 120 is
21 provided.

22

23 The actuating element 100 is moved by virtue of the
24 shoulder 120 contacting a formation in the well bore.
25 This formation may be the upper edge of a liner or
26 polished bore receptacle. Initially when the shoulder
27 120 contacts the formation, the tool remains in the
28 position shown in the Figure. In this position the ports
29 110 are obturated by the sleeve 112 and fluid can be
30 pumped through the bore 50. Weight can then be set down
31 upon the tool 10, this weight causes the body 20 to drop
32 relative to the sleeve 102 and the helical spring 104
33 will be compressed. Travel of the sleeve 102 is limited

1 by a shoulder 125 contacting a surface 127 formed as a
2 lock on the body 20. This helps prevent the spring 104
3 becoming spring bound. When the shoulder 125 abuts
4 against the lock 127 the groove 114 is adjacent to the
5 ports 110 and the ports 110 in the body 20 communicate
6 with a ports 130 on the sleeve 102. It will be
7 appreciated that ports 130 are equivalent to the ports
8 56, 58 of Figure 1 and thus fluid from the bore 50 again
9 can pass into channel 54. To close the ports 130 weight
10 is lifted off the tool and the spring 104 biases the
11 sleeve 102 to return to the position shown in Figure 3.

12

13 A principal advantage of the present invention is that it
14 combines a number of functions on a single tool within a
15 well bore. A further advantage of the present invention
16 is that it can provide an increased annulus velocity for
17 hole cleaning due to the small clearance provided between
18 the ports 44 and the inner surface of the well bore or
19 tubular in use.

20

21 It will be appreciated by those skilled in the art that
22 this tool can replace a conventional stabiliser used in a
23 bottom hole assembly. Further, drilling can be performed
24 with this tool mounted in the bottom hole assembly and
25 the tool can be also used to pump mud while drilling.
26 Alternatively, the tool can be used to jet clean the low
27 pressure housing, the high pressure well head and
28 downhole casing adapter profile, as it is more effective
29 than using the bit and does not require an extra trip
30 into the well. The tool can further be run in
31 conjunction with a mud motor and can be used to shut down
32 the bit at the shoe to minimise casing wear while
33 pumping. It will also be appreciated that the tool may

1 be run in conjunction with an under reamer and can be
2 used to deactivate blades at a shoe. Thus it can be used
3 in preference to dropping a dart.

4
5 Advantageously the present invention provides a large
6 outer diameter jetting and circulating device that acts
7 as a drilling stabiliser as well and can be activated by
8 different means one or more times. Thus, specific areas
9 within the well can be jetted at various times without
10 retrieval of the string from the well.

11
12 Various modifications may be made to the invention herein
13 described without departing from the scope thereof.
14 Primarily it will be appreciated that any actuating means
15 which provides selective opening and closing of a channel
16 in the body of the tool may be incorporated as one or
17 more of the actuating means in the tool of the present
18 invention.